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X.—*On the Mode of Growth of* Stromatopora, *including the Commensalism of* Caunopora. By H. J. Carter, F.R.S. &c.

Struck with the practical nature of Mr. Champernowne's remarks on "some Devonian Stromatoporidæ from Dartington, near Totnes," published in the Quart. Journ. Geol. Soc. for February 1879, I lost no time in putting myself in communication with him on this subject, and having received, in reply, a kind invitation to visit the "Pit-Park Quarry" (whence his specimens had been taken), I availed myself of the opportunity on the 8th of May last.

During our inspection of the quarry, as well as during the short time I was with Mr. Champernowne, I learnt no less from the former than from the latter, whose cautious observations, combined with his opportunities of obtaining practical information, rendered his remarks very valuable in a scientific point of view.

On my return to this place (Budleigh-Salterton) I washed the specimens brought away from the Quarry, and dissected them by fracture, section, and polishing, as far as such means and such material would admit, whereby I learnt much more.

My general inference from our visit to the Quarry was that *Stromatopora* was essentially a "reef-building" organism, and that, like *Millepora alcicornis* in the West Indies, it grew

profusely in its locality, not only entering and filling up the open interstices of other calcareous organisms during their growth, but enveloping their detritus (joints and stems of Encrinites, &c.), and, when not doing either of these things, growing into large masses of itself. Thus, by cementing every thing together after this manner, the great reef appears to have been formed which is now known by the name of "Devonian Limestone." This is not only evidenced by the composition of the *solidified* strata generally, when cut and polished, but more convincingly and particularly by a portion of it in "Pit-Park Quarry," which, having undergone partial decomposition, now yields up its contents even more separately than probably they have ever been since they were bound together by the ubiquitous *Stromatopora*.

In the first place, I could not help seeing how often *Stromatopora* had grown on *Favosites*; and on turning to the specimen which led me to the remarks on *Caunopora* in my paper on the probable nature of the animal of *Stromatopora* ('Annals,' 1878, vol. ii. pp. 311, 312), I felt constrained to fall back upon this coral; and I also saw that, although perfectly right as regards the difference between the "axial" and "tubulated" structure in *Millepora alcicornis* (ib. p. 316 &c.), this could not be applied to *Caunopora*.

Herein I was much influenced by Mr. Champernowne's showing me what Dr. Duncan had pointed out to him, viz. that the supposed genus "*Battersbya*" of MM. Edwards and Haime, who placed it among the Milleporidæ, consisted of a coral the interstices of which were filled up with a *Stromatopora*; so that, virtually, there was no such organism. We next examined specimens of *Syringopora*, in which the same thing was observed to have taken place. But why should I recount more instances of this nature when I have already stated that "Pit-Park Quarry" bore evidence of *every thing*, both living and dead, having been overrun by *Stromatopora* (including *Caunopora* under this head) during the formation of the "reef."

All this led me, on my return home, to again see what Baron Rosen had stated and illustrated of *Stromatopora Schmidtii*. I then found that *S. Schmidtii* could not be a species of *Caunopora*, as stated in my paper (*l. c.* p. 319); and, on referring to Rosen's account (p. 80), this was confirmed by his statement that Roemer was "right" in considering *Caunopora placenta*, Lonsdale, nothing but the tubes of a "coral" surrounded by *Stromatopora*.

To this view I am now inclined to accede, as to the presence of these tubes indicating that of an organism dif-

ferent from the matrix in which they are enveloped, after the manner of *Battersbya* &c., but not as regards an equally "coral" nature of the tubes, as will be seen hereafter; and, if this view be right, then, by eliminating *Caunopora* from the Stromatoporidæ, much will be gained by the latter in simplification. Still Rosen's general division of the structure of the *Stromatoporæ* into "curvilinear" and "rectilinear" cœnenchyma will remain the same; and the remark in my paper (*l. c.* p. 312), that in *Caunopora* I saw the same kind of *granulated* curvilinear fibre as in the coral called *Battersbya*, becomes intelligible.

That the tubes of *Caunopora* are adventitious or different from the curvilinear cœnenchyma of *Stromatopora*, which generally accompanies them, is proved by their occasional presence in another kind of Stromatoporoid cœnenchyma, *i. e.* in *Stromatopora elegans*, Rosen (vulg. "Stagshorn" hereabouts), of which I possess two specimens; while, in support of this, Mr. Champernowne states that the stromatoporoid cœnenchyma of *Caunopora* is "as variable as the *Stromatopora* itself is variable;" add to this that the different kinds of cœnenchyma constantly occur *without* the tubes peculiar to *Caunopora*.

Further, it happens that in a polished section of a specimen of *Caunopora* from "Pit-Park Quarry," which Mr. Champernowne gave me, the lower surface (which is in its natural state) is terminal; that is, the tubes do not pass through it, while at the bottom of the *polished part*, close to the angle it forms with the "natural surface," the tubes may be observed to turn out of their vertical course and become united to a horizontal tortuous tubulation simulating that of the *hydrorhiza* of hydroid zoophytes, which, under this aspect, appears to form the whole of the "natural surface;" and hence the ends of the tubes of the *Caunopora* do not project through this matted structure, as in most cases where the fractured part of the specimen has passed through the tubes themselves.

If this should be substantiated, then we can understand how the tubes of *Caunopora*, for the most part, should be without walls, *i. e.* appear as mere spaces, seeing that, while one kind of *Syringopora* was probably a calcareous hydroid, the tubes of *Caunopora* might, for the most part, have belonged to a chitinous or flexible kind, which in fossilization would only be represented as a mould made by the cœnenchyma of the *Stromatopora*. Still, as Mr. Champernowne observes, "crystallization, we know, acts, apparently, in the most capricious manner, and it *may* be the cause of these different aspects."

Here I might observe that the infundibular structure of *Syringopora* appears to be allied to the diaphragms produced by the "annulation" (or circular constrictions of the tube) which is such a very common feature among the flexible Hydroids, and thus frequently appears in a modified form in the tubes of *Caunopora*—the effect of such constrictions being to force the cœnosarcal tube into the centre of the flexible horny one, which in *Syringopora geniculata*, from the tubular processes of the infundibula passing into each other, gets beyond a mere constriction, and thus sometimes becomes a continuous calcareous central canal.

The tubes of *Caunopora* are, for the most part, straight or slightly flexuous, equal in calibre, unbranched and parallel in their course, and, although hardly ever appearing otherwise than in short fragments, were found by Mr. Champernowne, in a weathered-out instance from "Pit-Park Quarry," to attain $1\frac{3}{4}$ inch in length; so that it may fairly be assumed that, if it were not for their slightly flexuous course, they would be found to be continuous throughout, *i. e.* from their origin to their termination. But it by no means follows that because the main tubes pursued this course they were not often united by smaller ones, after the manner of *Syringopora*, from which it becomes almost impossible to separate them in every respect when all their structural *varieties* are taken into account.

Seeking among the flexible Hydroids for one that would afford analogous features, we find it in *Tubularia indivisa*, which grows so luxuriantly on our coasts, of which the Rev. T. Hincks (Hist. Brit. Hydroid Zoophytes, 1868, vol. i. p. 115) gives the following characters of the polypary, viz.:— "Clustered, simple, erect, without annulation, narrowed and twisted at the base, horn-coloured, rising to a height of from 6 to 12 inches." The tubes are about 1-16th of an inch in diameter, and seldom divide except near the hydrorhiza, which consists of "twisted and interwoven tubes often agglomerated together." But then there are not only other species of *Tubularia* which divide throughout much oftener, but one, viz. *T. bellis*, which is annulated throughout (*op. cit.* Atlas, pl. xxi.).

Now such Hydroid Zoophytes, whether flexible or calcareous, if overgrown with *Stromatopora*, would represent *Caunopora*; and if we require a similar instance of commensalism, it is afforded in *Stephanoscyphus mirabilis*, which Prof. Allman found on the south coast of France, and describes as consisting of a horny sponge traversed by "a congeries of tubes which penetrate the sponge-tissue and open on its surface, united by a common tubular plexus towards the base."

Dr. F. E. Schulze, of Gratz, subsequently found this in the Adriatic Sea, where the hydroid polyp &c. designated by him *Spongicola fistularis* was found to be the denizen of several different kinds of sponges; and his representation (Archiv f. mikroskop. Anatomie, Bd. xiii. Taf. xlii. fig. 8) might, the sponge being replaced by *Stromatopora*, pass for a specimen of *Caunopora* with the tubes much branched.

Again, it should be remembered that in commensalism the host is hardly ever without its guest; so that it becomes the habit of the latter to dwell with the former even from the commencement of life, and, while the guest may never be seen without its host, the latter is occasionally seen without its guest. In a beautiful preparation which Dr. F. E. Schulze has just kindly sent me, the guest, viz. *Oscillaria spongetiæ*, is already present in the *embryo* of *Spongetia pallescens*, which it afterwards pervades throughout life (Zeitschrift f. wiss. Zool. Bd. xxxii. p. 149, Taf. v. fig. 7). So that it is not surprising that *Caunopora*, i. e. the host and its guest *together*, should be occasionally found surrounding Corals also together in the way above mentioned.

I am aware that all but Roemer and Rosen (that is, all English authors on the subject) have, from Lonsdale downwards, viewed *Caunopora* as a distinct species of *Stromatopora*; but I myself now cannot help, from the facts above mentioned, regarding it as an instance of commensalism; and in this I am supported by Mr. Champernowne.

The fact, however, that *Caunopora* may thus be found to be a compound of two organisms does not invalidate what I have stated respecting *Millepora alcicornis*, in which there are distinct tubes among the Stromatoporoid cœnenchyma rising from an axial structure of a different form. *Millepora alcicornis*, too, overruns every thing in its way; thus, in the British Museum there is a large *Murex*, together with reticulated *Gorgoniæ*, covered with it. Ellis notices that it is one of the commonest corals in Jamaica, where it is principally used for burning into lime (Nat. Hist. Zoophytes, 1786, p. 142), and afterwards mentions a bottle that became incrusted with it; so that, as the branches coalesce between themselves, and in like manner this species of *Millepora* attaches to *itself* every foreign body that comes in its way, a reef-accumulation may be thus produced, similar to that which was built up by *Stromatopora*. By eliminating *Caunopora*, therefore, the description of *Stromatopora* is not only more simplified, but *Millepora alcicornis* and the *Hydractiniæ* are brought together, which, as Mr. Champernowne observes, afford the best key to a right understanding of what *Stromatopora* really was.

Again, with reference to my statement, that in the sponges the excretory canal-system commences in the ampullaceous sacs (*Wimperkörbe*) (Ann. 1878, vol. ii. p. 322), I have now to modify this assertion; for my figure of the pore-area in *Greyella cyathophora* directly opening into an excretory canal (Ann. 1869, vol. iv. pp. 192, 193, pl. viii. fig. 5, &c.), confirmed by that of *Axos spinipoculum* (ib. 1879, vol. iii. p. 290, pl. xxv. fig. 4, &c.), shows at least that a commencement in the ampullaceous sacs is not always the case, and presents quite a new feature in the offices of the excretory canals of sponges; although it does not alter the fact that the system is partly excretory in the sponge, while the stellate venation often appears *without any aperture at all* (Rosen, Taf. xi. fig. 7), as the hydrophyton or proliferous organ in *Stromatopora*.

Since the above was written I have seen C. F. Roemer's 'Rheinische Uebergangsgebirge,' 1844, in which, at p. 57, he observes that *Caunopora placenta*, Phillips, is "nichts Anderes, als *Stromatopora polymorpha* von Syringoporen durchwachsen," and, further, that the specimens from the Eifel, the Silurian outliers of Mark Brandenburg and Silesia, together with those of the Devonian Limestone are "undistinguishable."

XI.—*Description of a new Species of Porcupine from the Philippine Islands.* By Dr. A. Günther, F.R.S.

Before Mr. Everett left the Philippine Islands he obtained at Puerto Princesa, in the island of Paragua, a specimen of a small kind of Porcupine, which evidently is undescribed. It is distinguished at the first glance by its small size and by the shortness of its tail. In many respects it resembles *Hystrix crassispinis* from Borneo, but is considerably smaller and the quills are less thick. The specimens sent by Mr. Everett consist of the skin of a female which is nearly full-grown, and of the perfect skeleton of a very old male. The species may be called

Hystrix pumila.

All the upper and lateral parts of the body are densely covered with flat, deeply grooved, flexible bristles of moderate length. These bristles are gradually developed into spines on the hinder part of the back, the shorter spines continuing to be provided with a shallow groove above. The strongest